(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Kubista et al.

Application No.: 10/687,458 — Confirmation No.: 8780

Filed: October 15, 2003 — Art Unit: 1734

For: SYSTEMS FOR DEPOSITING MATERIAL ONTO WORKPIECES IN REACTION CHAMBERS AND METHODS FOR REMOVING BYPRODUCTS FROM REACTION CHAMBERS — Examiner: R. Zervigon

APPEAL BRIEF

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This brief is filed within four months of the mailing of the Notice of Panel Decision from Pre-Appeal Brief Request for Review mailed September 14, 2006, and is in furtherance of the Notice of Appeal filed August 8, 2006.

The fees required under § 41.20(b)(2) are dealt with in the accompanying TRANSMITTAL OF APPEAL BRIEF. A separate Petition for Extension of Time and the requisite fees are filed concurrently herewith.

This brief contains items under the following headings as required by 37 C.F.R. § 41.37 and M.P.E.P. § 1206:

I. REAL PARTY IN INTEREST

The real party in interest for this appeal is Micron Technology, Inc.

II. RELATED APPEALS, INTERFERENCES, AND JUDICIAL PROCEEDINGS

There are no other appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

A. Total Number of Claims in Application

There are 8 claims pending in application.

B. Current Status of Claims

1. Claims canceled: 1-15 and 24-45
2. Claims withdrawn from consideration but not canceled: none
3. Claims pending: 16-23
4. Claims allowed: none
5. Claims rejected: 16-23

C. Claims On Appeal

The claims on appeal are claims 16-23.

IV. STATUS OF AMENDMENTS

A Pre-appeal Brief Request for Review was filed August 8, 2006. No claims were added, amended, or cancelled after the issuance of the Final Office Action mailed May 8, 2006.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Thin film deposition techniques are widely used in the manufacturing of microfeatures to form a coating on a workpiece that closely conforms to the surface topography. (*See e.g.*, Specification, 1:12-14). One widely used thin film deposition technique is Chemical Vapor Deposition (CVD). (*See e.g.*, Specification, 1:21-22). In a CVD system, one or more precursors that are capable of reacting to form a solid thin film are mixed while in a gaseous or vaporous state, and then the precursor mixture is presented to the surface of the workpiece. (*See e.g.*, Specification, 1:23-25).

Atomic Layer Deposition (ALD) is another thin film deposition technique. (*See e.g.*, Specification, 2:14). According to this technique, a layer of gas molecules A first coats the surface of a workpiece by exposing the workpiece to a precursor gas containing A molecules and then purging the chamber with a purge gas to remove excess A molecules. (*See e.g.*, Specification, 2:16-19). The layer of A molecules is then exposed to another precursor gas containing B molecules that can react with the A molecules to form an extremely thin layer of solid material on the workpiece. (*See e.g.*, Specification, 2:23-25).

In a typical single-wafer CVD or ALD reactor, a reaction chamber is coupled to a gas supply and a vacuum. (*See e.g.*, Specification, 3:5-6). In operation, the vacuum maintains a negative pressure in the reaction chamber to draw the gases from the gas supply across the workpiece and then through an outlet of the reaction chamber. (*See e.g.*, Specification, 3:12-15). A trap positioned

between the reaction chamber and the vacuum captures and collects the byproducts from the reaction chamber to prevent fouling of the vacuum. (*See e.g.*, Specification, 3:16-17, Figure 3).

One drawback of both ALD and CVD processing is the downtime required to service or replace the trap. (*See e.g.*, Specification, 3:24-25). As the trap collects byproducts from the reaction chamber, the byproducts restrict the flow from the reaction chamber to the vacuum, and consequently, the pressure in the chamber increases. (*See e.g.*, Specification, 3:26-27). The increased pressure in the reaction chamber impairs effective removal of the byproducts from the reaction chamber. (*See e.g.*, Specification, 3:27-28). Accordingly, the trap is cleaned or replaced periodically to avoid significant increases in the pressure in the reaction chamber. (*See e.g.*, Specification, 3:29-30). Servicing the trap requires that the reactor be shut down, which results in a reduction in throughput. (*See e.g.*, Specification, 4:1-2).

A. <u>Claim 16</u>

Several embodiments of the present invention resolve the above-described drawback of having to shut down the reactor to service the trap by positioning a second trap and a throttling valve in a second branchline to regulate the flow of byproducts into the second trap while collecting the byproduct with the first trap. (*See e.g.*, Specification, 7:6-30). For example, one embodiment of a system for depositing material onto a workpiece in a reaction chamber is set forth in claim 16. (*See e.g.*, Specification, Figure 4-6). The system includes a reaction chamber and a mainline coupled to the reaction chamber. The mainline has a first branchline and a second branchline each downstream from the reaction chamber. The system further includes a first trap in the first branchline and a second trap in the second branchline to collect byproducts from the reaction chamber, a throttling valve in the second branchline, a pressure monitor to determine a pressure difference between a pressure in the mainline upstream from the first trap and a pressure in the mainline downstream from the first trap, a vacuum pump coupled to the mainline, and a controller operably coupled to the pressure monitor and the throttling valve. (*See e.g.*, Specification, 8:1-30). The controller having a computer-readable medium containing instructions that cause the controller to perform a method comprising:

- exhausting byproducts from the reaction chamber through the first trap in the first branchline;
- determining the pressure difference across the first trap caused by a flow of the byproducts by monitoring the pressure monitor;
- dynamically controlling the flow of byproducts into the second trap in the second branchline by regulating the throttling valve; and
- maintaining the pressure differential across the first trap in the mainline based on the determined pressure difference. (*See e.g.*, Specification, 9:8-28).

B. Claim 20

In another embodiment, as set forth in claim 20, the controller has a computer-readable medium containing instructions that cause the controller to perform a method comprising:

- exhausting byproducts from the reaction chamber through the first branchline;
- collecting byproducts in the first trap in the first branchline;
- monitoring the difference between the pressure in the mainline upstream of the first trap and the pressure in the mainline downstream of the first trap;
- regulating the throttling valve in the second branchline in response to the monitored pressure differential in the mainline to flow byproducts into the second branchline; and
- maintaining the pressure differential in the mainline within a desired range by regulating the throttling valve. (*See e.g.*, Specification, 9:8-28).

Several embodiments of systems in accordance with claims 16 and 20 are useful in deposition processes because they can prolong the run time of the reaction chamber. The reaction chamber can operate until both the first and second traps are filled up with byproducts. Thus, the systems in accordance with claims 16 and 20 do not need to be shut down after the first trap is only partially constricted, as in prior art systems. Systems in accordance with claims 16 and 20 can accordingly produce high quality films on microelectronic substrates and have long run times.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 16-23 were rejected under 35 U.S.C. § 103(a) over the combination of (a) U.S. Patent No. 6,402,806 to Schmitt et al. ("Schmitt") and (b) U.S. Patent No. 6,022,483 to Aral ("Aral").

VII. GROUPING OF CLAIMS

Appellant believes that the following groups of claims 16-23 are separately patentable. Claims 16-23 do not stand or fall together with respect to the rejection under 35 U.S.C. § 103(a), but instead are grouped together as follows:

Group I: Claims 16-19

Group II: Claims 20-23

An argument in support of the foregoing groupings of Claims 16-23 is provided below in Section VIII(A).

VIII. ARGUMENT

Claims 16-23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Schmitt in view of Aral. "[T]he examiner bears the initial burden of presenting a *prima facie* case of obviousness." *In re Rijckaert*, 9 F.3d 1531, 1532, 28 USPQ2d, 1955, 1956 (Fed. Cir. 1993). To establish a *prima facie* case of obviousness, the Examiner needs to (a) identity prior art references that disclose all the elements of the claims, and (b) provide a suggestion to combine the references. (M.P.E.P. § 2143.) As set forth in detail below, the Examiner has failed to satisfy the burden of presenting a *prima facie* case of obviousness because (1) the proposed combination would change the principle of operation of Schmitt's bypass trap and render Schmitt's system unsatisfactory for its intended purpose; and (2) even if combined, the combined teachings of Schmitt and Aral still do not teach or suggest all the limitations of the pending claims.

A. Grouping of Claims

Group I consists of claims 16-19. Claims 16-19 recite a system for depositing material onto

a workpiece in a reaction chamber that includes a controller that can dynamically control the flow of byproducts into the second trap in the second branchline by regulating the throttling valve. As claims 16-19 recite a system distinctive from other system claims, Group I properly states a separately patentable claim group.

Group II consists of claims 20-23. Claims 20-23 recite a system for depositing material onto a workpiece in a reaction chamber that includes a controller that can regulate the throttling valve in the second branchline in response to the monitored pressure differential in the mainline. As claims 20-23 recite specific system distinctive from the other system claims, Group II properly states a separately patentable claim group

B. Patentability of Group I – Claims 16-19

Claim 16 is directed to a system that includes a reaction chamber, a mainline coupled to the reaction chamber, and a vacuum pump coupled to the mainline. The mainline has a first branchline and a second branchline, and each branchline is downstream from the reaction chamber. A first trap and a second trap are respectively placed in the first and second branchlines to collect byproducts from the reaction chamber. The system also includes a throttling valve placed in the second branchline and a pressure monitor placed to determine the pressure difference across the first trap. A controller is operably coupled to the pressure monitor and the throttling valve. The controller includes a computer-readable medium containing instructions that cause the controller to perform a method that includes: (1) exhausting byproducts from the reaction chamber through the first trap; (2) determining the pressure difference across the first trap caused by a flow of the byproducts by monitoring the pressure monitor; (3) dynamically controlling the flow of byproducts into the second trap by regulating the throttling valve; and (4) maintaining the pressure differential across the first trap in the mainline within a desired range based on the monitored pressure difference.

Schmitt discloses a method for recovering un-reacted precursor components in a CVD process (Abstract). A hot trap is placed downstream of the reaction chamber followed by a primary cold trap (Figure 5). A bypass cold trap is arranged in parallel with the primary cold trap to allow continued CVD operation while removing and replacing the primary cold trap (column 6, lines 22-24). During operation, the primary inlet valve and the primary outlet valve of the primary cold trap

are open while the bypass inlet valve and the bypass outlet valve are closed (column 6, lines 36-40). As the primary cold trap fills up with byproducts, the pressure differential across the primary cold trap rises (column 6, lines 45-47). After the pressure differential exceeds a selected limit, the primary cold trap needs to be replaced (column 6, lines 47-50). During switching, the CVD process is stopped, and the primary inlet valve is first closed to allow purging the primary cold trap (column 6, lines 58-60). After purging, the primary outlet valve is closed, and the bypass inlet and outlet valves are opened to allow the CVD process to resume (column 7, lines 1-4). As a result, the bypass cold trap is designed to operate as a backup for the primary cold trap, not to operate jointly with the primary cold trap during normal operation.

Aral discloses a system for controlling the pressure in a chamber with a computer controlled exhaust throttle valve (Abstract). The pressure in the chamber is monitored by a pressure sensor and controlled by adjusting exhaust throttle valve that is coupled to a vacuum pump (Column 3, lines 41-43). In operation, a static relationship between the exhaust flow rate, the throttle valve position, and the chamber pressure is first determined (Column 4, lines 3-5). Then, if the measured chamber pressure is, for example, above a setpoint, a controller increments the desired exhaust flow rate according the error between the measured chamber pressure and the setpoint (Column 6, lines 7-9). Then, the throttle valve position is calculated based on the determined static relationship between the exhaust flow rate, the throttle valve position, and the chamber pressure (Column 6, lines 8-12).

One of ordinary skill in the art would not modify Schmitt's system as suggested by the Examiner because, among other reasons, Schmitt teaches away from combining with Aral. In the May 8 Final Office Action, the Examiner stated "[M]otivation to add Aral's exhaust control apparatus to Schmitt's system is for controlling Schmitt's reactor pressure as taught by Aral." (Office Action, May 8, 2006, page 7). However, this rationale ignores explicit teachings in Schmitt against such a modification. In particular, such a modification would change the principle of operation of Schmitt's system. Schmitt discloses a bypass trap parallel to a primary trap to allow either trap to be removed and replaced without unduly disrupting the product flow through the processing chamber. Thus, Schmitt's bypass trap is designed to operate as a backup for the primary

trap during normal operation. If Schmitt's bypass trap were used with Aral's throttling valve to maintain a desired pressure drop across the primary trap, Schmitt's backup trap would be operating concurrently with the primary trap instead of being a standby backup in direct opposition to Schmitt's teachings.

In addition, such a modification would render Schmitt's system unsatisfactory for its intended purpose. One of Schmitt's design goals is to avoid unduly disrupting the product flow through the processing chamber. As a result, Schmitt discloses alternatively operating the primary and backup traps so that when one trap is serviced, the other can keep the deposition process operating. If Schmitt's bypass trap were used with Aral's throttling valve to operate jointly with the primary trap, the product flow through Schmitt's processing chamber would be unduly disrupted because <u>both</u> traps must be serviced at the same time after sufficient byproducts have been collected. As a result, Schmitt's processing chamber cannot continue to operate because the path for the product flowing from the processing chamber is now blocked. Thus, disruption to the product flow through Schmitt's processing chamber cannot be avoided. Accordingly, the proposed modification would render Schmitt's system unsatisfactory for its intended purpose of having undisrupted flow through the processing chamber.

Even if Schmitt and Aral were combined as suggested by the Examiner, the combined teachings of Schmitt and Aral fail to disclose or suggest several features of claim 16. For example, the combined teachings of Schmitt and Aral fail to disclose or suggest "a throttling valve in the second branchline" of claim 16. Instead, Schmitt discloses a block valve in the second branchline upstream of the backup trap, and Aral does not disclose any trap branchline at all. Thus, if the teachings of Schmitt and Aral were to be combined, the resulting system would include Aral's exhaust throttling valve at the discharge of Aral's process chamber, and such a location would be upstream of Schmitt's primary and bypass traps instead of in any of these branchlines. As a result, the combined teachings of Schmitt and Aral still do not disclose or suggest "a throttling valve in the second branchline."

Moreover, the combined teachings of Schmitt and Aral fail to disclose or suggest a controller that includes a computer-readable medium containing instructions that cause the controller to perform a method that includes "dynamically controlling the flow of byproducts into the second trap by regulating the throttling valve," as recited in claim 16. Instead, Schmitt teaches operating only one trap at a time. Specifically, Schmitt discloses "during normal operation, the primary inlet valve 505 and the primary outlet valve 511 of the primary cold trap are open, while the bypass inlet valve 515 and bypass outlet valve 517 are closed." (Schmitt at column 6, lines 36-39). "The effluent path is generally not switched during a CVD wafer deposition process, but is switched after a wafer deposition process has finished and before the next [process] has started." (Schmitt at column 6, lines 54-57). Thus, the exhaust from Schmitt's process chamber would not be admitted into the bypass trap because during normal operation, "the bypass inlet valve and the bypass outlet valve are closed." Aral does not teach or suggest having traps between the exhaust throttle valve and the vacuum pump. As a result, the combined teachings of Schmitt and Aral do not disclose or suggest controlling the flow of byproducts into the second trap.

In addition, the combined teachings of Schmitt and Aral fail to disclose or suggest a controller that includes a computer-readable medium containing instructions that cause the controller to perform a method that includes "maintaining the pressure differential across the first trap in the mainline within a desired range based on the monitored pressure difference." Instead, Aral teaches monitoring and maintaining the pressure (instead of a pressure difference) in the process chamber based on the monitored process chamber pressure, and Schmitt discloses monitoring whether the pressure differential across the primary cold trap exceeds a preset threshold. Thus, neither references disclose or suggest maintaining the pressure differential across the traps, which is not the pressure in the reaction chamber.

Accordingly, the current rejection of claim 16 does not comply with Section 103(a) because (1) the proposed modification to Schmitt would destroy the purpose of the bypass trap in Schmitt; and (2) the combined teachings of Schmitt and Aral do not teach or suggest all the limitations of the pending claims. Therefore, the Section 103(a) rejection of claim 16 is improper and should be reversed. Claims 17-20 depend from claim 16. Accordingly, the Section 103(a) rejection of claims

217-20 is improper and should be reversed for at least the reasons discussed above with reference to claim 16 and for the additional features of these claims.

C. Patentability of Group II – Claims 20-23

Claim 20 is directed to a system for depositing material onto a workpiece in a reaction chamber. The system includes a reaction chamber and a mainline coupled to the reaction chamber. The mainline has a first branchline and a second branchline each downstream from the reaction chamber. The system also includes a first trap in the first branchline to collect byproducts from the reaction chamber, a second trap in the second branchline to collect byproducts from the reaction chamber, a throttling valve in the second branchline, a pressure monitor to determine a pressure difference between a pressure in the mainline upstream from the first trap and a pressure in the mainline downstream from the first trap, a vacuum pump coupled to the mainline, and a controller operably coupled to the pressure monitor and the throttling valve. The controller has a computer-readable medium containing instructions that cause the controller to perform a method comprising (1) exhausting byproducts from the reaction chamber through the first branchline, (2) collecting byproducts in the first trap in the first branchline, (3) monitoring the difference between the pressure in the mainline upstream of the first trap and the pressure in the mainline downstream of the first trap, (4) regulating the throttling valve in the second branchline in response to the monitored pressure differential in the mainline to flow byproducts into the second branchline, and maintaining the pressure differential in the mainline within a desired range by regulating the throttling valve.

One of ordinary skill in the art would not be motivated to modify Schmitt's system as suggested by the Examiner because Schmitt teaches away from combining with Aral as described above with reference to Group I. Further, even if Schmitt were combined with Aral, the combined teachings of these references still fail to disclose or suggest several features of claim 20. For example, in addition to the arguments discussed above with respect to Group I, neither Schmitt nor Aral disclose "a controller ... having a computer-readable medium containing instructions that cause the controller to perform ... regulating the throttling valve in the second branchline in response to the monitored pressure differential in the mainline..." Instead, Aral's throttling valve is

regulated to maintain the pressure in the process chamber based on the monitored process chamber pressure, and Schmitt's pressure differential across the primary cold trap is not used as a process variable at all. Further, neither Schmitt nor Aral disclose "maintaining the pressure differential in the mainline within a desired range by regulating the throttling valve." Schmitt discloses monitoring the pressure differential as an indicator for a clogged trap, not maintaining the pressure differential.

Accordingly, the Section 103(a) rejection of claim 21 is improper and should be reversed for at least the reasons discussed above with reference to claim 1 and for the additional features of claim 16. Claims 22 and 23 depend from claim 21. Accordingly, the Section 103(a) rejection of claims 22 and 23 is improper and should be reversed for at least the reasons discussed above with reference to claim 21 and for the additional features of these claims.

IX. CLAIMS

A copy of the claims involved in the present appeal is attached hereto as Appendix A. As indicated above, the claims in Appendix A do include the amendments filed by Applicant on February 10, 2006.

X. EVIDENCE

No evidence pursuant to §§ 1.130, 1.131, or 1.132 or entered by or relied upon by the examiner is being submitted.

XI. RELATED PROCEEDINGS

No related proceedings are referenced in II. above, or copies of decisions in related proceedings are not provided, hence no Appendix is included.

Applicants believe no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 50-0665, under Order No. 108298726US from which the undersigned is authorized to draw.

Dated: January 16, 2007

Respectfully submitted,

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APPENDIX A

Claims Involved in the Appeal of Application Serial No. 10/687,458

1-15. (Canceled).

16. (Previously presented) A system for depositing material onto a workpiece in a reaction chamber, the system comprising:

a reaction chamber;

a mainline coupled to the reaction chamber, the mainline having a first branchline and a second branchline each downstream from the reaction chamber;

a first trap in the first branchline to collect byproducts from the reaction chamber;

a second trap in the second branchline to collect byproducts from the reaction chamber;

a throttling valve in the second branchline;

a pressure monitor to determine a pressure difference between a pressure in the mainline upstream from the first trap and a pressure in the mainline downstream from the first trap;

a vacuum pump coupled to the mainline; and

a controller operably coupled to the pressure monitor and the throttling valve, the controller having a computer-readable medium containing instructions that cause the controller to perform a method comprising –

exhausting byproducts from the reaction chamber through the first trap in the first branchline;

determining the pressure difference across the first trap caused by a flow of the byproducts by monitoring the pressure monitor;

dynamically controlling the flow of byproducts into the second trap in the second branchline by regulating the throttling valve; and

maintaining the pressure differential across the first trap in the mainline based on the determined pressure difference.

17. (Original) The system of claim 16 wherein the first branchline and the second branchline are configured in a parallel arrangement.

18. (Previously presented) The system of claim 16 wherein:

the mainline further includes a third branchline and a fourth branchline each downstream from the first and second branchlines;

the vacuum pump comprises a first vacuum pump coupled to the third branchline; and

the system further comprises a second vacuum pump coupled to the fourth branchline.

19. (Original) The system of claim 16 wherein the throttling valve comprises a first valve, and wherein the system further comprises a second valve in the first branchline upstream of the first trap and a third valve in the first branchline downstream of the first trap.

20. (Previously presented) A system for depositing material onto a workpiece in a reaction chamber, the system comprising:

a reaction chamber;

a mainline coupled to the reaction chamber, the mainline having a first branchline and a second branchline each downstream from the reaction chamber;

a first trap in the first branchline to collect byproducts from the reaction chamber;

a second trap in the second branchline to collect byproducts from the reaction chamber;

a throttling valve in the second branchline;

a pressure monitor to determine a pressure difference between a pressure in the mainline upstream from the first trap and a pressure in the mainline downstream from the first trap;

a vacuum pump coupled to the mainline; and

a controller operably coupled to the pressure monitor and the throttling valve, the controller having a computer-readable medium containing instructions that cause the controller to perform a method comprising –

exhausting byproducts from the reaction chamber through the first branchline;

collecting byproducts in the first trap in the first branchline;

monitoring the difference between the pressure in the mainline upstream of the first trap and the pressure in the mainline downstream of the first trap;

regulating the throttling valve in the second branchline in response to the monitored pressure differential in the mainline to flow byproducts into the second branchline; and

maintaining the pressure differential in the mainline within a desired range by regulating the throttling valve.

21. (Original) The system of claim 20 wherein the first branchline and the second branchline are configured in a parallel arrangement.

22. (Previously presented) The system of claim 20 wherein:

the mainline further includes a third branchline and a fourth branchline each downstream from the first and second branchlines;

the vacuum pump comprises a first vacuum pump coupled to the third branchline; and

the system further comprises a second vacuum pump coupled to the fourth branchline.

23. (Original) The system of claim 20 wherein the throttling valve comprises a first valve, and wherein the system further comprises a second valve in the first branchline upstream of the first trap and a third valve in the first branchline downstream of the first trap.

24-45. (Canceled).